The Case for Risk Assessment as the Remedial Option of Choice

RemTech 2020

October 14, 2020

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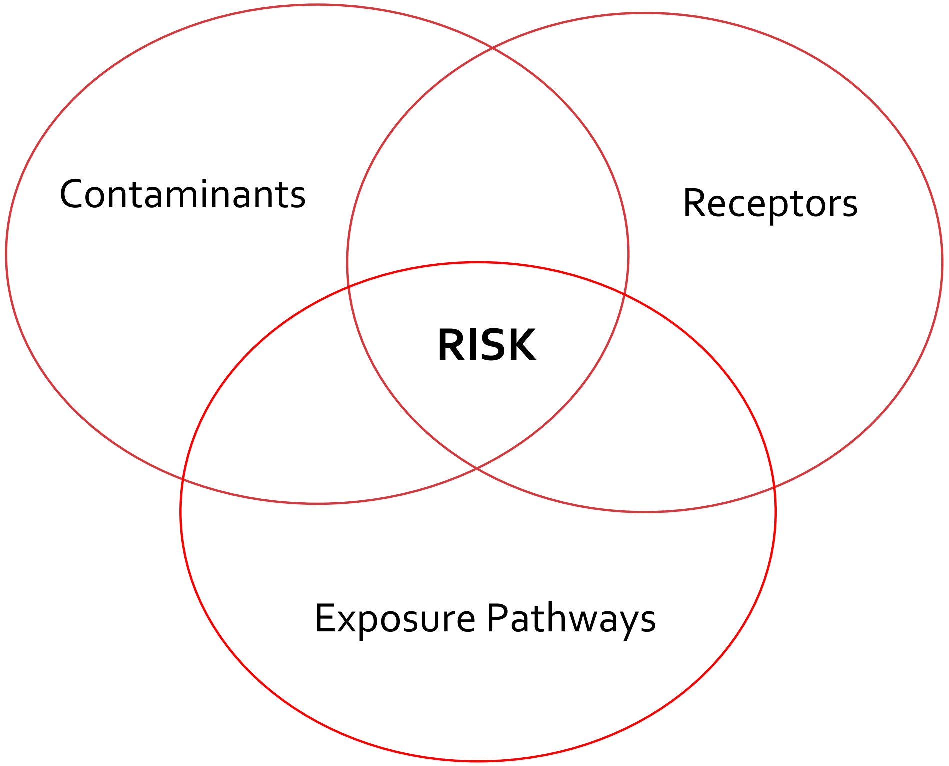
Overview

- Brief Overview of Risk Assessment
- How, why, and when RA is best option
- Case study
- Advantages and opportunities
- Considerations

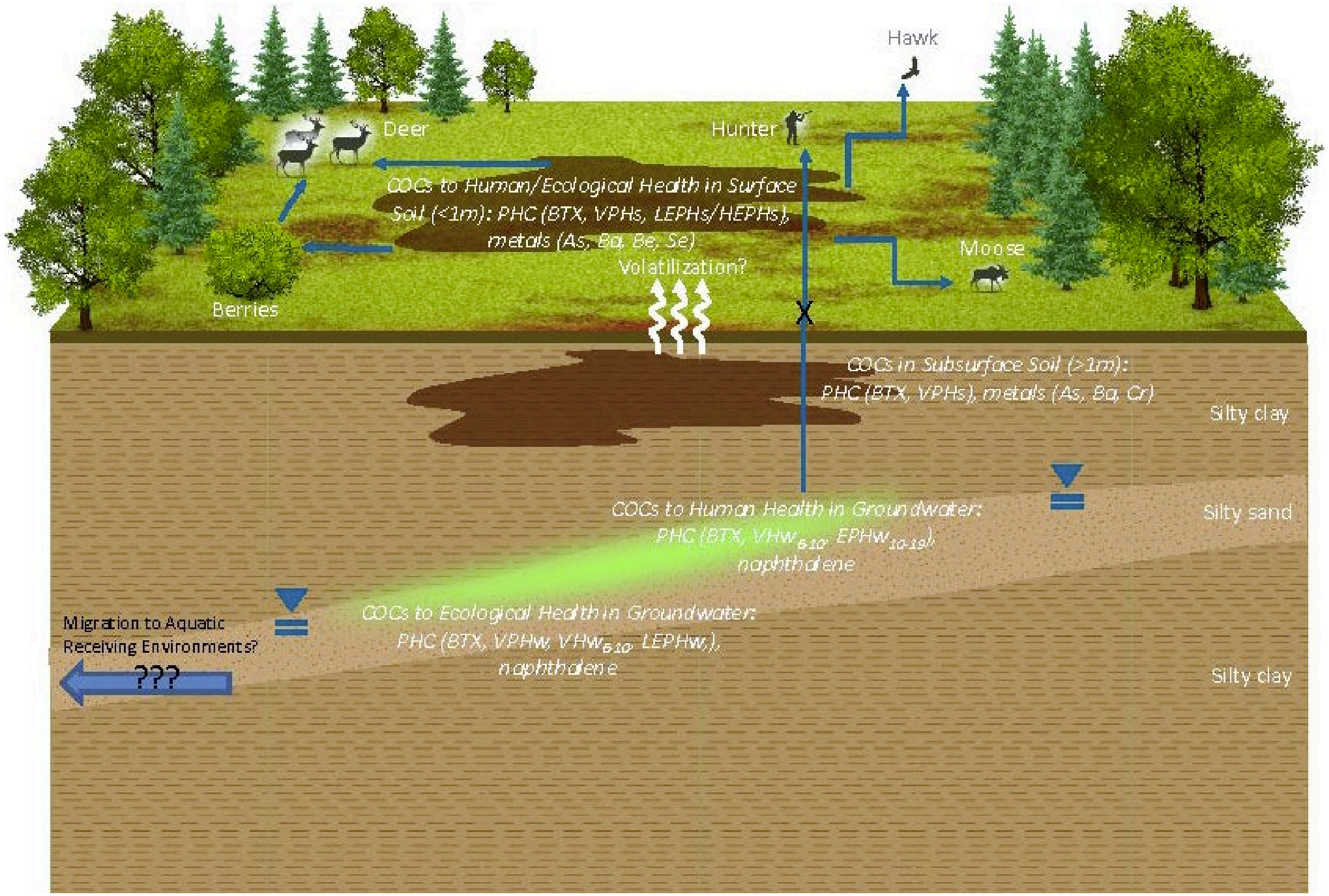
Risk Assessment 101

- Presence of contamination ≠ risk
- RA evaluates potential for adverse effects due to chemical, physical, or biological stressors



Risk Assessment 101

- Identifies potential contaminants of concern, receptors, and exposure pathways



Risk Assessment 101

- Each RA is unique to the site for which it was prepared
- Calculations run to estimate receptor doses via operable exposure pathways
- Determines cancer and non-cancer risks (humans)
- Used by EPA since 1980s. In BC since 1987

Good Risk Assessment…

- Must be useful for the purposes for which it is intended.
- Must be understandable.
- Is complete, informative, and useful for decision-makers.

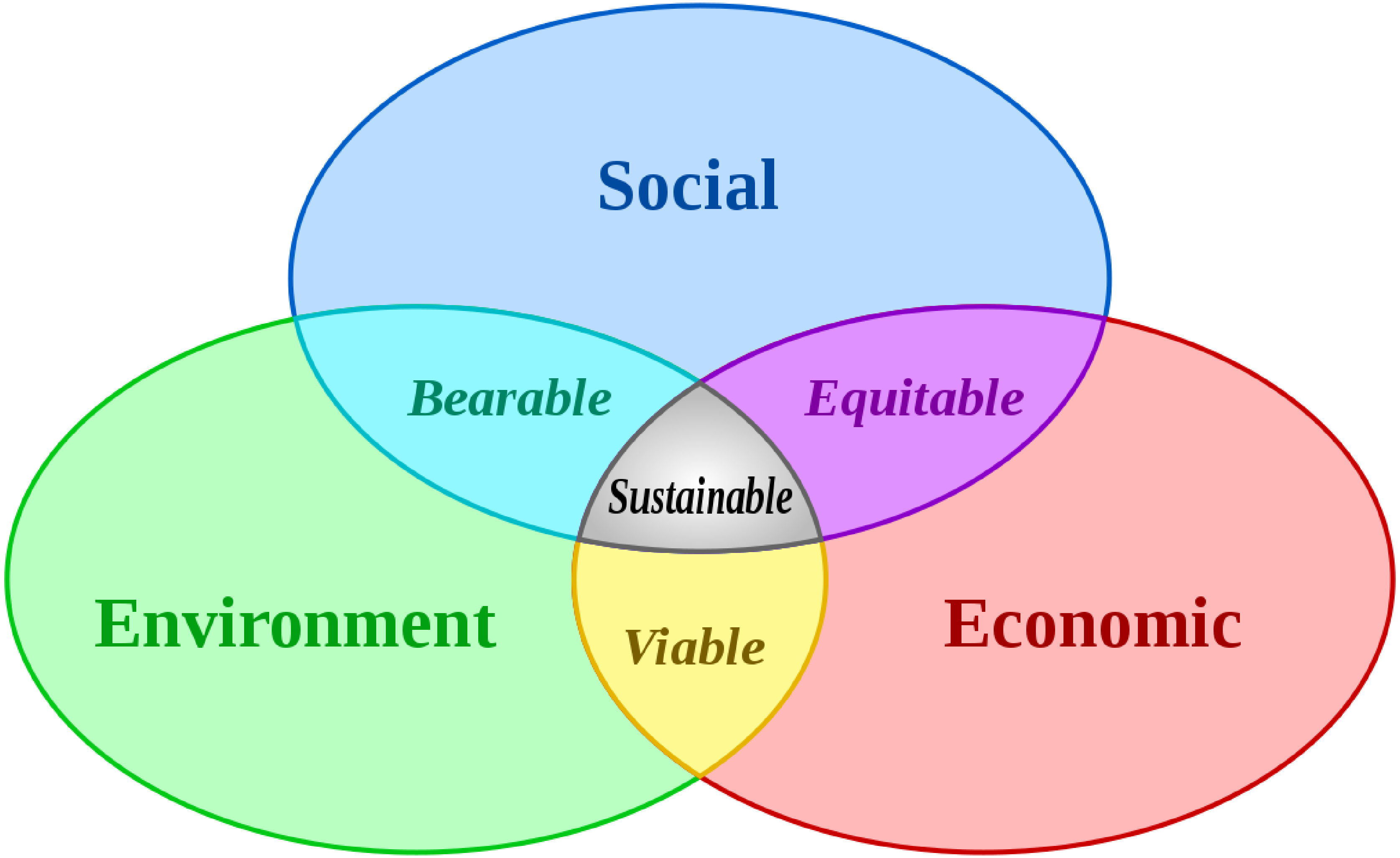
RA in Canada

- RA is commonly-used across Canada, the US, and in Europe as a form of remediation
- Some jurisdictions allow on a restricted basis for screening; seem to prefer physical remediation
  - Opportunities for time and cost efficiencies are numerous – esp with remote oil and gas sites

How When Why

- The international consensus is that risk-based land management provides the best available framework for decisions because (1) it provides an objective way to link actions to the prevention of harm, e.g., to human health or the wider environment; (2) it provides a rationale for how to intervene, i.e., which source–pathway–receptor linkages need to be broken to successfully mitigate unacceptable risks; (3) moreover, it provides a rationale to prioritise limited resources at the most serious/urgent problems/problem sites

How
When
Why



sciencedirect.com

How When Why

- Environmental
  - Fuel and electricity consumption
  - Use of chemicals
  - Soil and vegetation disturbance
  - Waste generation; space in landfills
- Economic
  - On average, about 75% less costly than physical remediation
  - Spend 20% of remediation cost to remove source and risk assess
- Social
  - Reduce travel in pandemic times
  - Acceptable risk should translate to no liability
  - Physical remediation doesn't remove liability (just relocates it)

How
When
Why

- In accordance with Federal and most provincial/territorial regulatory regimes
- Remote sites – combine engineering with toxicology
- When cost to physically remediate > land value
- Matrix standards don't reflect CEM
- Restrictions to site access (e.g., COVID)
- Sustainability/carbon intensity is a concern and/or goal
- Seasonal considerations

Case Study

Site Description

- Former well site, remote location
- Salt, metals, and PHC in soil; PHC in groundwater
- Contaminated attributed to a belowground leak in the former well or buried piping used to deliver process water to the well for injection
- Approximately 4,800m^2 impacted

Photo: revitalization.org

Case Study

Contaminants of Potential Concern

Parameter	Human Health	Terrestrial Ecological Health	Aquatic Ecological Health
Shallow Soil (<1m Depth)			
VPHs	None	●	Not Applicable
Subsurface Soil (≥1m Depth)			
Sodium	None	●	Not Applicable
Chloride		●	
Xylenes		●	
VPHs		●	
LEPHs		●	
Groundwater			
VPHw	None	Not Applicable	●
LEPHw			●
Soil Vapour			
None			
Sediment			
None			
Surface Water			
None			

Case Study

Receptors

- Human: recreators
- Terrestrial ecological: soil invertebrates, plants, birds, mammals, amphibians, reptiles
- Aquatic ecological: invertebrates, vegetation, fish, aquatic birds and mammals in nearby river and lake

Photo: grandviewoutdoors.com

Case Study

Exposure Pathways – Human

- No current wells in surrounding area; no future DW expected due to remote location, absence of agricultural, residential, industrial water supply needs
- No plans to redevelop site; expected to continue to evolve into wildlands
- No COPCs for human health

No operable exposure pathways

Case Study

Exposure Pathways – Terrestrial Ecological

- Soil invertebrates – direct contact with surface soil
- Plants – direct contact with soil
- Wildlife – direct contact, incidental soil ingestion

Operable exposure pathways to surface soil (<1m depth)

Case Study

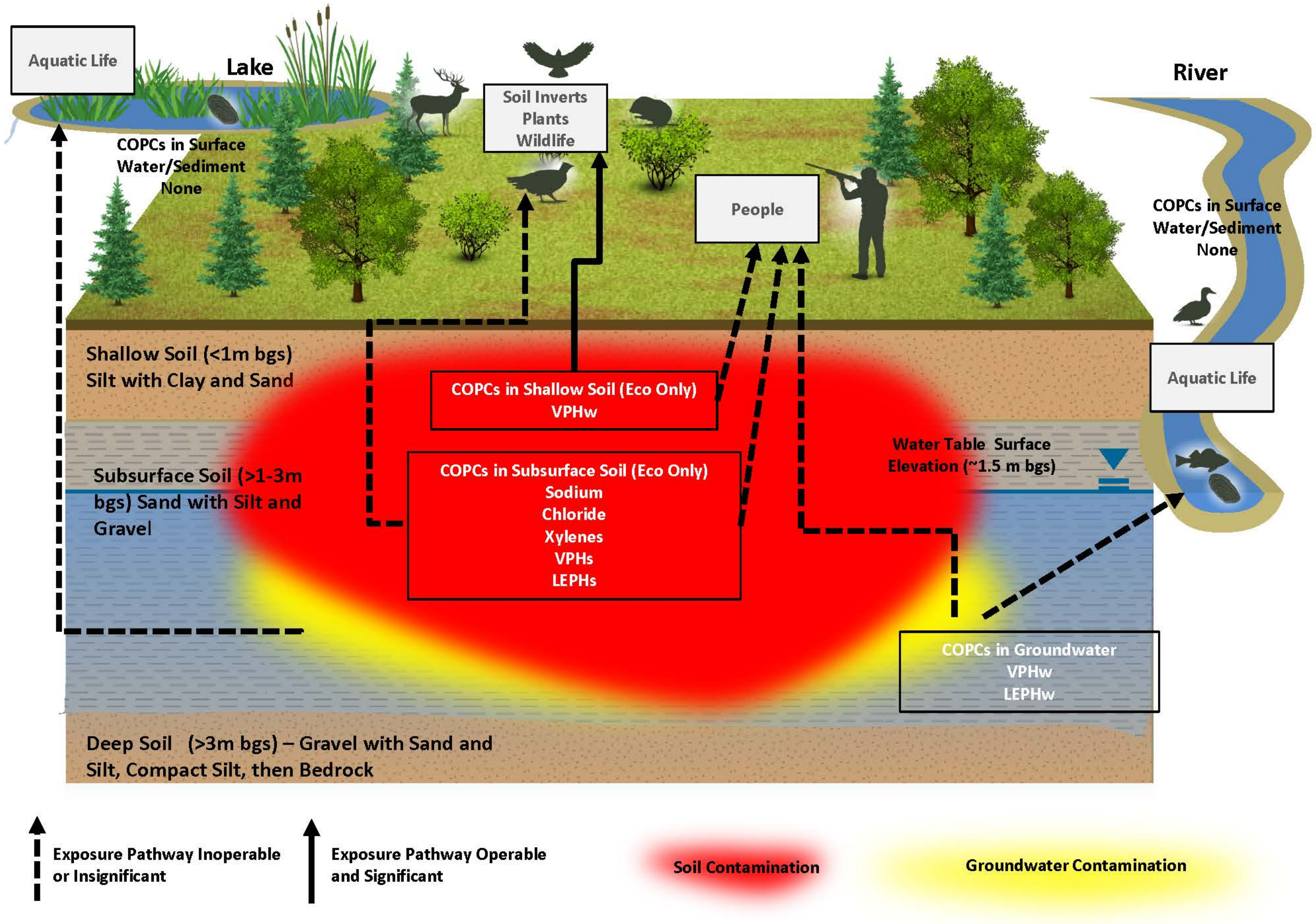
Exposure Pathways – Aquatic Ecological

- Groundwater impacts sufficiently delineated, stable or decreasing
- Not impacting water quality of nearby river or lake
- Not affecting sediment quality
- River not expected to erode into impacted areas of the Site

No operable exposure pathways

Case Study

Conceptual Exposure Model



Case Study

Exposure Assessment

- Statistical analysis of VPH concentrations in surface soil
  - 90th percentile used as EPC for immobile receptors (soil invertebrates and plants)
  - 95 UCLM selected as EPC for wildlife

Case Study

Effects Assessment

- BC CSR standard for VPH is generic
- Alberta Environment & Parks surface soil quality guidelines for F1 used as toxicity reference values

Case Study

Risk Characterization

- Integrates findings of exposure and effects assessments
- Determines likelihood of VPH in surface soil causing adverse effects
- Three components:
  - Risk Estimation
  - Uncertainty Analysis
  - Risk Description

Case Study

Risk Characterization

- Risk estimates <1 for soil invertebrates, plants, wildlife indicating negligible risk
- Uncertainties indicate risk estimates overestimate actual ecological risks at site
- Risk descriptions low and acceptable for all eco receptors

Advantages and Opportunities

- Remote sites
- When land value < physical remediation costs
- When site access is restricted or difficult
- Less costly approach could expedite closure of more contaminated sites
- Class-level RA for similar sites (e.g., O&G, airports, fuel storage facilities)
- Source removal + RA
- Achieve/support corporate sustainability goals

Tips for Site Investigators

- Involve Risk Assessors early on in project planning
- Get site-specific cost estimate from Risk Assessors
- Ensure Risk Assessors understand project goals so that the RA is adequate, robust, and valuable for decision-making
- Consider the environmental fate of chemicals (can't assume concentrations measured today will exist in perpetuity)

Tips for Risk Assessors

- Be transparent!
- Risk Assessors – educate your colleagues and clients
    - Stakeholder education + engagement = acceptance of RA

Tips for Regulators

- Consider the big picture
- Be pragmatic!
- Allow for assumptions
- Weigh the environmental, social, and economic benefits

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